Geos3.3 based Clear Sky TOA Radiance & Fluxes

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Introduction

- Multi-source Temperature & Humidity profiles used in FuLiou code
- Compared with CERES TOA Clear
 Sky Longwave Radiance and Flux data

Fu-Liou Radiative Transfer Code

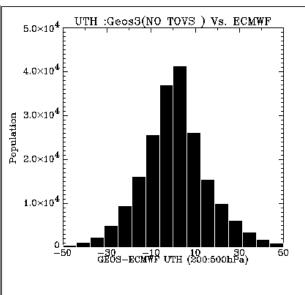
- 12 Longwave bands (0-2200cm-1)
- 3 Window bands (800-1250cm-1)
- Filtering of Window based on Modtran parameterization and TRMM widow spectral response
 - Function(band#,Unfilter Radiance,vza)
- Parameterized CKD 2.1 Continuum
- Updated absorption k's (Kratz)
- Sw & Lw Scattering Aerosols & Clouds

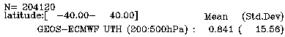
DATA: March 7-9 2000

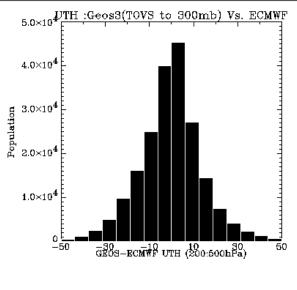
- **GEOS3.3** itc004
 - ◆ TOVS to 300mb (to100mb in Future release)
- ECMWF (current MOA product)
 - ◆ TOVS to 100mb
- SSF (TRMM-PFM-VIRS_CALEd1)
 - ◆ CLEAR SKY using SSF cloud mask
 - Observed TOA: OCEAN & LAND Subsets
 - Filtered Window Radiance
 - Total LW Radiance
 - OLR

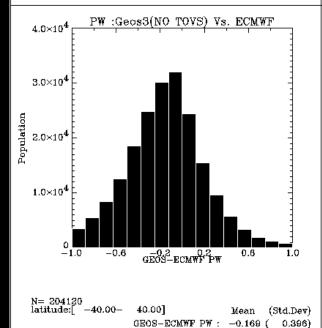
Upper Troposphere Humidity and Precipitable water Relative Comparison of Geos(with and without TOVS) to ECMWF(with Tovs)

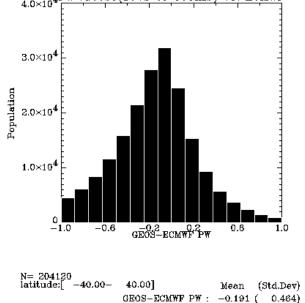
- •Single day (3-8-00)
- •6 hourly
- •Grid box to grid box
- •ALL SKY
- •TROPICS



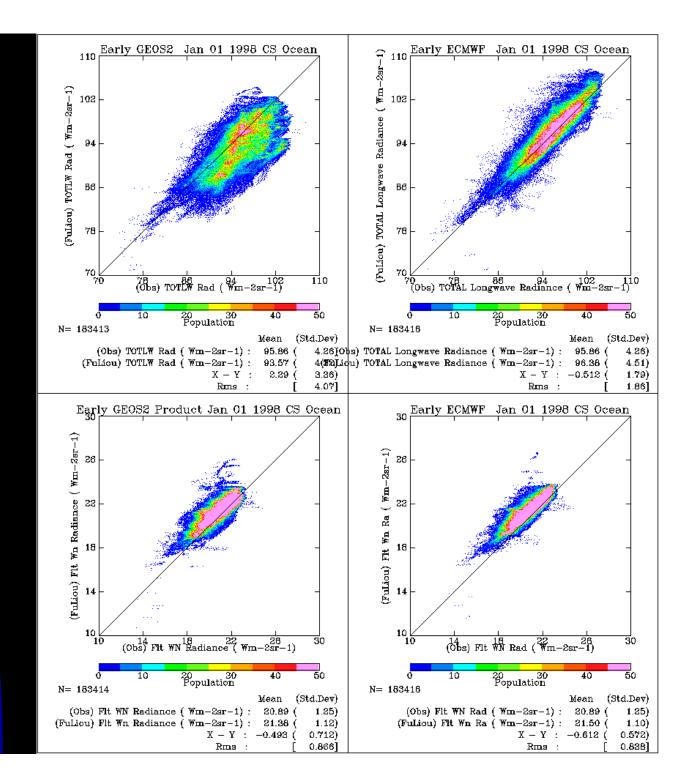




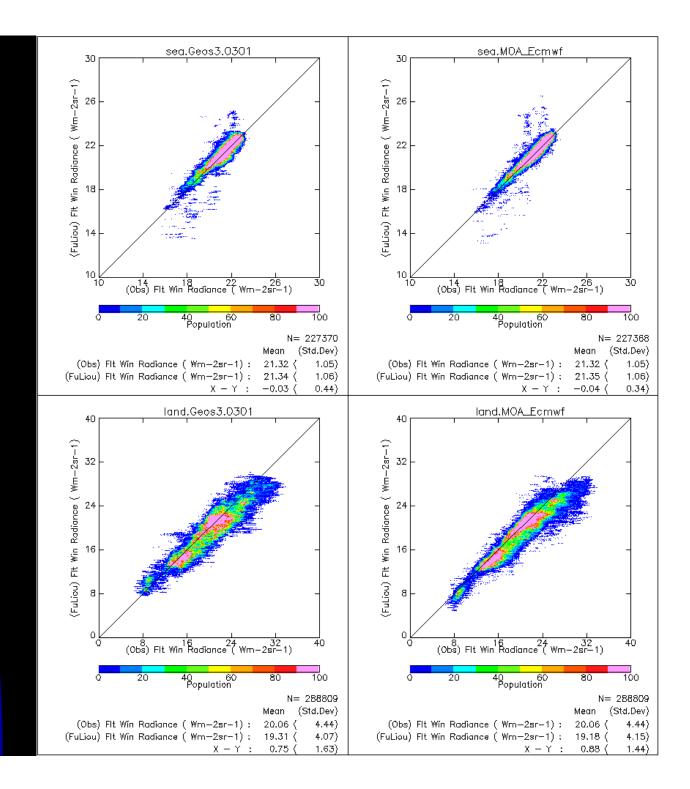




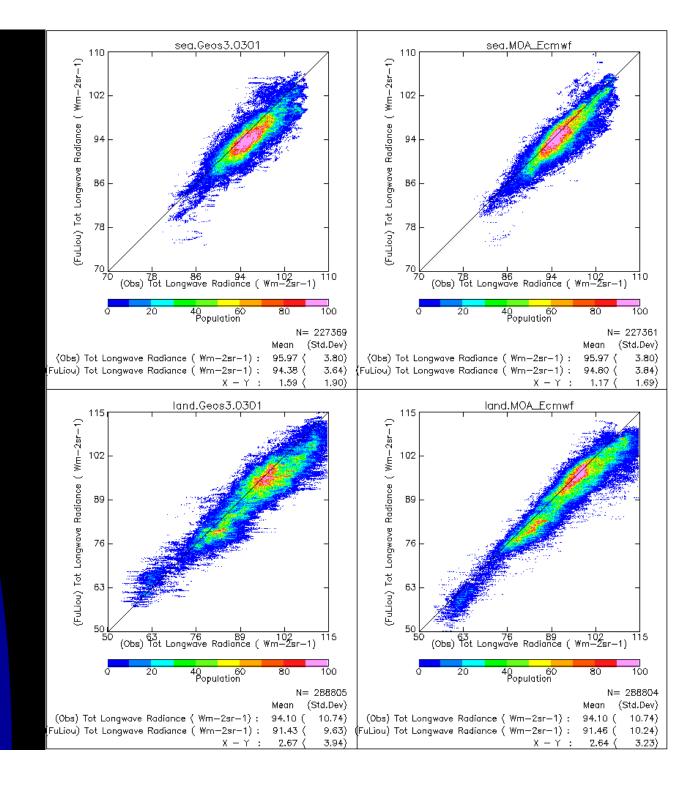
Early Geos2 & Ecmwf Results



Filtered Window Radiance

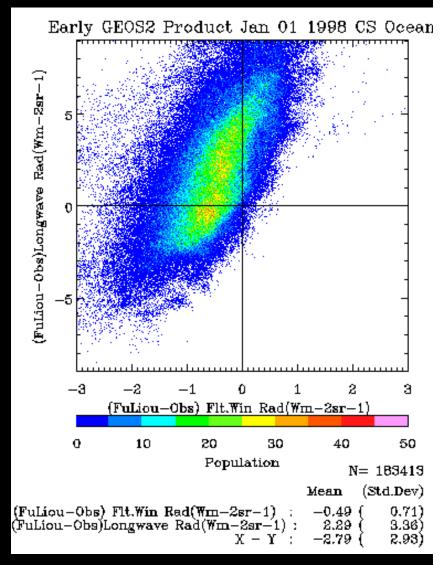


Total LW Radiance



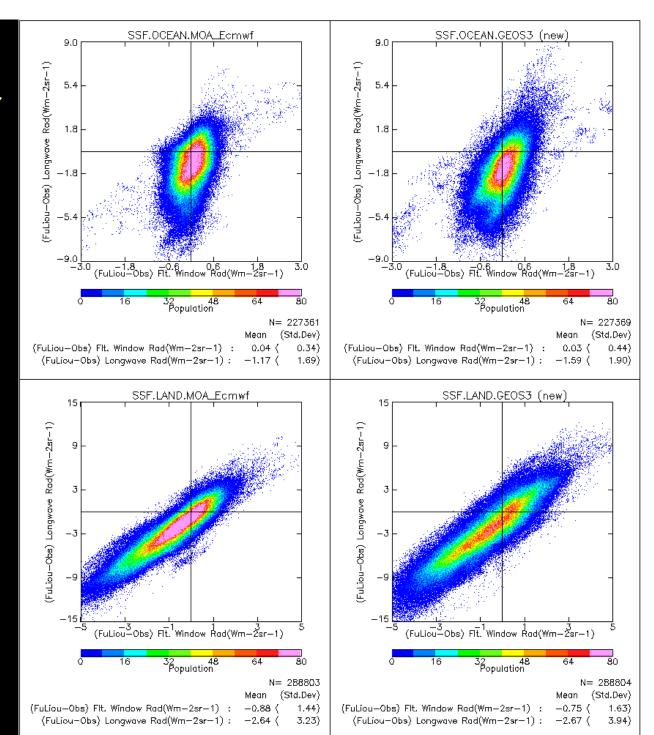
Old Geos 2 Radiance Error Space Result

- Early results using Geos2
 Temperature & Humidity had
 large RMS error of LW Radiance
 - ◆ Bias 2.3 wm-2 sr-1
 - Error Stddev 3.4 wm-2 sr-1
- We also had to improve our parameterization of filtered window radiance in the fuliou code since then. This used an early spectral response.
- ES8 MLE Cloud Mask

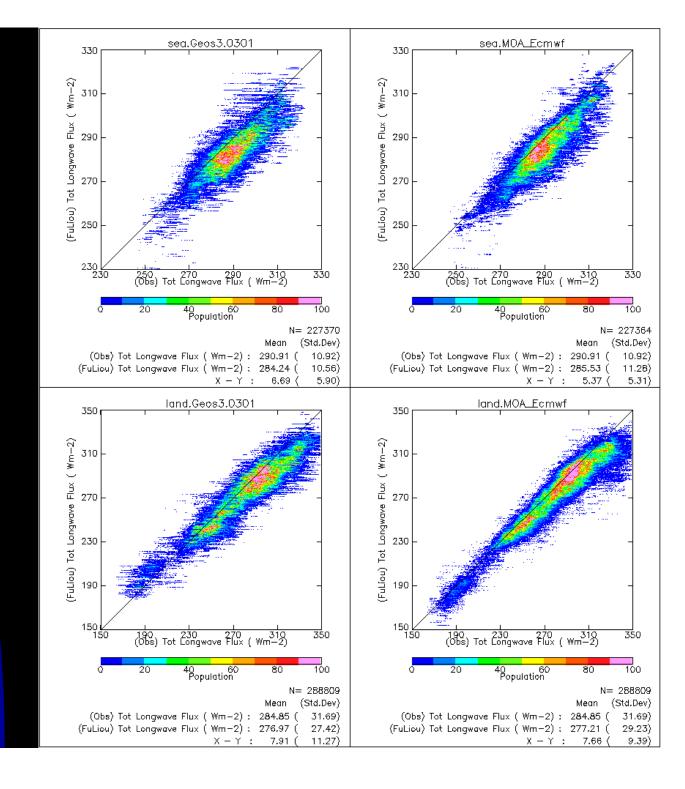


Geos3.3 & ECMWF

Filtered window Vs
Total Longwave
(Model-Observed)
Error space Plot



OLR

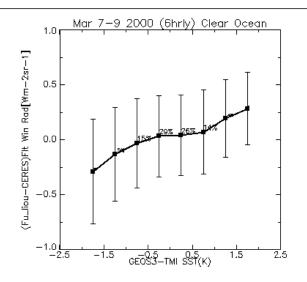


Model Vs Observed Biases

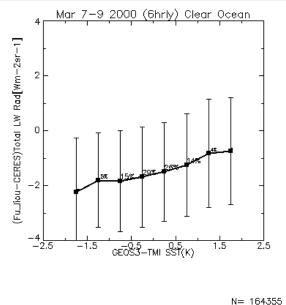
- FuLiou Model Bias larger than GEOS Vs ECMWF product differences
- Bias Sources
 - Fast Process:Temporal Variability(TMI)
 - ◆ FuLiou Spectral Coverage(0:2200cm-1)
 - H20 Continuum:CKD2.3 Vs CKD2.1
 - Misc.
 - Grid Vs Footprint scale (clear sky subset)
 - Surface spectral emissivity
 - Aerosol
 - Vertical resolution (30 levels) More in CRS

Fast Processes

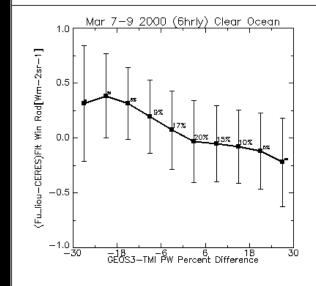
Variability of
Water Vapor (PW)
and SST using
Instantaneous TMI



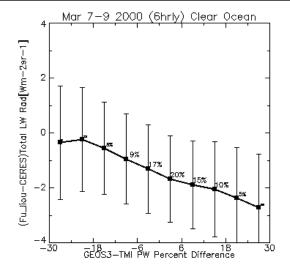
| N= 164356 | Mean (Std.Dev) | GEOS3-TMI SST(K): -0.07 (0.81) | (Fu_liou-CERES)FIt Win Rad[Wm-2sr-1]: 0.02 (0.40)



| Mean (Std.Dev)
| GEOS3-TMI SST⟨K): -0.07 ⟨ 0.81)
| (Fu_liou-CERES)Total LW Rad[Wm-2sr-1]: -1.57 ⟨ 1.86)



| N= 178494 | Mean | (Std.Dev) | GEOS3-TMI PW Percent Difference : 3.68 (15.42) | (Fu_liou-CERES)Flt Win Rad[Wm-2sr-1] : 0.03 (0.40)

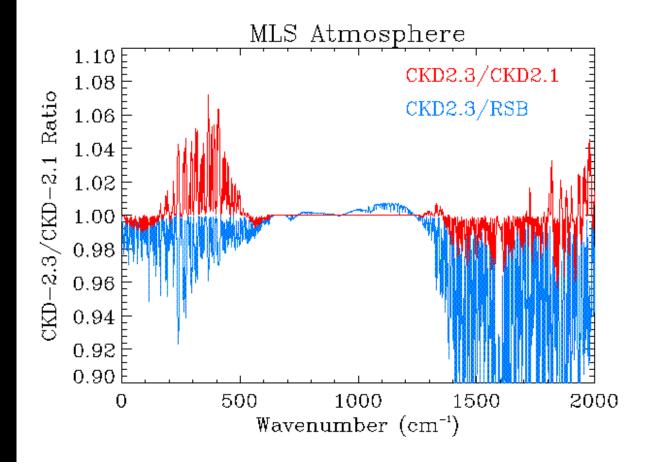


| N= 178493 | Mean (Std.Dev) | GEOS3-TMI PW Percent Difference : 3.68 (15.42) | (Fu_liou-CERES)Total LW Rad[Wm-2sr-1] : -1.57 (1.85)

Continuum

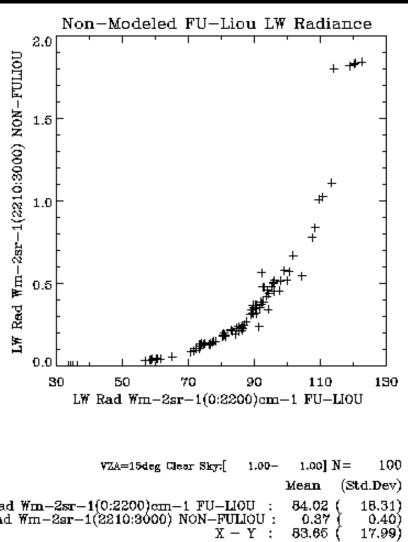
- OLR with CKD2.3 is ~ 1Wm-2 greater than CKD2.1
- Based on line by line calculations D. Kratz
- FuLiou currently contains CKD2.1

H20 Continuum
Differences (0:600cm-1)
of particular
Importance in cold
Upper troposphere



Spectral Coverage

- Fuliou Code only covers (0: 2200) cm-1 in the Longwave
- Significant underestimate of Total LW Radiance and OLR at large Skin Temperatures i.e.. Daytime Desert
- Toa Radiance error larger at nadir
- Typical error MLS Ocean:
 - 0.4 Wm.-2sr-1 radiance
 - → ~1.2 Wm.-2 flux omitted



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Rad Wm-2sr-1(0:2200)cm-1 FU-LIOU :
kad Wm-2sr-1(2210:3000) NON-FULIOU :
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Miscellaneous Causes

- Grid Vs Footprint Scale UTH
 - Udelhoffen & Hartman study UTH & Clouds
 - Partly Cloudy Grid boxes and Subgrid scale UTH variability
 - Clear sky observations sample dryer subset
 - Grid Mean value used in model calculations
- Fixed Aerosol Tau ocean & land
 - Sea Salt and Mineral Dust have LW effect
- Surface Emissivity
 - ◆ Literature based spectral dependence
- Vertical Resolution only 30 levels (linear interpolation)

Conclusions

- Geos3.3 (itc004) product is NOT the Final assimilation product to be delivered to CERES
 - Missing Tovs (300-100mb)
 - Possible (1-3) Wm-2 effect on OLR
- Clear Sky LW radiance simulations using GEOS3.3 much improved over earlier Geos2 release
- LW Radiance StdDev of Error reduced from 3.4 to 1.9 wm-2 sr-1 Now similar to ECMWF of 1.7 wm-2 sr-1
 - Tovs inclusion
 - Convection Scheme
 - ◆ RH wrt ICE
- Radiance simulation w/ECMWF "slightly better" but bias error attributable to GEOS/ECMWF UTH differences are small (<1</p>
- 17 Wm-2 sr-1) 001